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GROUNDWATER MONITORING REPORT
ANNUAL EVENT
MARCH 2002

BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

PREPARED FOR:

BOEING REALTY CORPORATION
5760 KILROY AIRPORT WAY, SUITE 500
LONG BEACH, CALIFORNIA 90806

JUNE 24, 2002

HALEY & ALDRICH

REPORT ON
GROUNDWATER MONITORING – ANNUAL EVENT
MARCH 2002
BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

by

Haley & Aldrich, Inc.
San Diego, California

for

Boeing Realty Corporation
Long Beach, California

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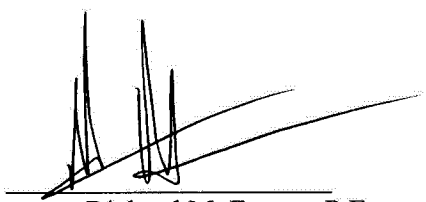

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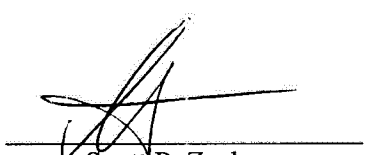

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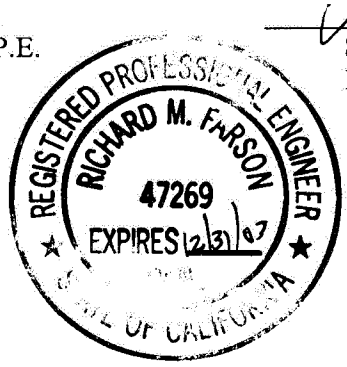

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I. INTRODUCTION

Haley & Aldrich, Inc. (H&A) has prepared this report on behalf of Boeing Realty Corporation (BRC) to document the Groundwater Monitoring Annual Event (2002 Annual event) conducted at the BRC former C-6 Facility in Los Angeles, California (Site).

The 2002 Annual event at the Site was conducted from March 21 to 26, 2002. The program included the following activities:

- Measuring groundwater elevations in 30 wells.
- Sampling of groundwater from 30 wells and subsequent analysis for volatile organic compounds (VOCs) by US Environmental Protection Agency (EPA) Method 8260B.
- Field bioattenuation measurements in six wells for dissolved oxygen (DO) and oxidation-reduction potential (ORP).

This report provides documentation and discussion of the 2002 Annual event.

II. SITE BACKGROUND

2.01 Site Location

The Site is at 19503 South Normandie Avenue in Los Angeles, California in an area located between the cities of Torrance to the west and Carson to the east. A Site location map is included as Figure 1 and a Site plan map as Figure 2. The Site occupies approximately 159 acres.

The Site is bounded to the north by 190th Street; to the east by Normandie Avenue; to the west by the former Industrial Light Metals (ILM) facility; and to the south by the former Montrose facility and a residential area.

2.02 Site History

For 40 years (1952-1992) the Site had reportedly been used for the manufacturing of aircraft and aircraft parts. Prior to 1952, industrial uses of the Site included aluminum and steel production, and before 1940 the Site was reportedly farmland. A limited amount of assembly and activities related to warehousing continued through mid-2000. Currently the Site is demolished and various stages of redevelopment activities are underway.

Groundwater investigation activities at the Site began in 1987. Since then, a total of 40 groundwater monitoring wells have been installed at the Site. Prefixes of Site groundwater monitoring wells include BL, DAC, WCC, TMW and XMW. Thirteen of the 40 wells have been removed as a result of redevelopment activities. Table 1 is a compilation of the groundwater monitoring well details.

2.03 Regional Geology and Hydrogeology

The description of the geology and hydrogeology of the region surrounding the Site is drawn from reports published by the U.S. Geological Survey (USGS) (Poland and others, 1959) and the California Department of Water Resources (DWR, 1961). Reference is also made to previous reports prepared by Kennedy/Jenks Consultants for the Site.

The Site is located on a broad plain at an elevation of about 52 feet above mean sea level (MSL). The DWR and USGS define this area as the Torrance Plain, a Pleistocene-age marine surface and subdivision of the West Coast Basin/Coastal Plain of Los Angeles and Orange Counties. The ground surface in this area is generally flat with an eastward gradient of approximately 20 feet per mile (less than one-half percent). Surface drainage is generally toward the Dominguez Channel, approximately a mile to the east. The Dominguez Channel, in turn, flows southeastward toward the Los Angeles and Long Beach Harbors in San Pedro Bay.

The West Coast Basin includes a thick sequence (up to 13,000 feet) of marine and continental sediments (Miocene to Recent) deposited in a broad synclinal depression over a basement complex of igneous and metamorphic rocks. The uppermost sequence of deposits of interest within the West Coast Basin is as follows:

Youngest	Active Dune Sand
↑	Alluvium
	Older Dune Sand
↓	Lakewood Formation (upper Pleistocene)
Oldest	San Pedro Formation (lower Pleistocene)

The dune sands and alluvium are not present at the Site. The Lakewood Formation is mapped at the surface in the Site vicinity.

The Lakewood Formation (DWR, 1961), includes all of the upper Pleistocene deposits in the sediments in the Los Angeles Coastal Plain area. The deposits are of both marine and continental origin, representing stream transport and sedimentation along the Pleistocene marine plain. In the Site area, the Lakewood Formation may include the Semi-perched aquifer, the Bellflower Aquiclude, and the Gage Aquifer. The Semi-perched aquifer includes deposits described as Terrace Cover (Poland and others, 1959). Based on correlations of Site stratagraphic data to data from adjacent sites, it appears that the Semi-perched aquifer is absent at the Site. The Bellflower Aquiclude is a heterogeneous mixture of continental, marine, and wind-blown sediments, mainly consisting of clays with sandy and gravely lenses (DWR, 1961). The base of the Bellflower Aquiclude is about -100 feet above mean sea level (MSL) or about 150 feet below ground surface (bgs) in the Site area. The Gage Aquifer is a water-bearing zone of fine to medium sand and gravel confined by the Bellflower Aquiclude. It is reported to be approximately 40 feet thick in the Site area.

The Lakewood Formation is underlain by the Lower Pleistocene San Pedro Formation, which continues to approximately 1,000 feet bgs in the Site area. Major water-bearing zones within the San Pedro Formation are the Lynwood Aquifer and the Silverado Aquifer. These are reported to occur at approximately 300 and 500 feet bgs, respectively, in the Site area (DWR, 1961). The Silverado Aquifer is an important groundwater source in the Coastal Plain and is considered a source of drinking water (DWR, 1961).

2.04 Site Geology and Hydrogeology

A. Site Geology

Groundwater monitoring wells and soil borings drilled at the Site have encountered the Lakewood Formation. Monitoring wells extend to approximately 90 and 140 feet bgs. The top 20 to 50 feet below the Site are mainly fine-grained soils (predominantly silts and clays) that become thicker to the east. A sandy zone that dips downward to the east underlies the fine-grained soils. The sandy zone is generally 80 to 100 feet thick and contains layers of fine-grained sediment that also dip down to the east.

B. Site Hydrogeology

Groundwater samples from monitoring wells at the Site have been collected and analyzed on a regular basis since 1987. The uppermost groundwater at the Site appears to be under water table conditions at elevations of -12 to -15 feet msl (60 to 70 feet bgs). Regionally, this upper most groundwater appears to be within relatively permeable sediments of the Bellflower Aquiclude. Most of the monitoring wells are completed at or near the water table, at depths of approximately 55 to 90 feet. Two deeper wells, WCC-1D and WCC-3D, were completed in a deeper zone at approximately 115 to 140 feet bgs. Both of these wells have since been abandoned (Table 1).

The following primary hydrogeologic units are recognized in the general vicinity of the Site:

FORMATION	HYDROSTRATIGRAPHIC UNIT	
Lakewood Formation (Upper Pleistocene)	Bellflower Aquitard	Upper Bellflower Aquitard (UBF)
		Middle Bellflower Aquitard (MBF, MBFM, MBFC, MBFB/C)
		Lower Bellflower Aquitard (LBF)
	Gage Aquifer (GAGE)	
San Pedro (Lower Pleistocene)	Gage Lynwood Aquifer (GLA)	
	Lynwood Aquifer (LYNWOOD)	
	Unnamed Aquifer	
	Silverado Aquifer	

The relatively fine-grained Upper Bellflower Aquitard (UBF) is continuous across the area, but thins to the northwest. The UBF is comprised of laminated to massive yellowish brown muds with local sands and fossiliferous zones. The UBF is found at the surface beneath the Site and is approximately 25 feet thick.

The Middle Bellflower Aquitard (MBF) is a massive, light yellowish brown, fine to medium sand with local muddy zones. An extensive mud layer referred to as the Middle Bellflower Mud (MBFM) locally interrupts this sand. Where divided, the sand subunits are referred to as the B-Sand (MBFB) and C-Sand (MBFC). The MBFM is discontinuous across the area and is comprised of laminated silts and layered silts and very fine sands. Deeper borings at the former ILM facility and the Site do not always encounter the MBFM. The MBFB is found at an approximate elevation of 27 feet msl (25 feet bgs) at the Site and is generally from 25 feet to 40 feet thick. The MBFC is found at an approximate elevation of -23 to -38 feet msl (75 to 90 feet bgs) at the Site.

The fine-grained Lower Bellflower Aquitard (LBF) is reported to be continuous across the area. It occurs at an approximate elevation of -58 to -68 feet msl (110 to 120 feet bgs) and ranges in thickness from 10 to 25 feet thick. The LBF separates the Bellflower sands from the underlying Gage Aquifer. The Gage Aquifer in the Site vicinity is predominantly sand and ranges in thickness from 40 to 78 feet. No monitoring wells have been drilled into the Gage Aquifer at the Site.

III. GROUNDWATER SAMPLING PROCEDURES

3.01 Monitoring Plans

The 2002 Annual event at the Site was conducted from March 21 to 26, 2002, by Tait Environmental Management, Inc. (TEM) field personnel. Work was conducted in accordance with the following documents:

- *Groundwater Monitoring Workplan* 2002 by Haley & Aldrich, Inc., dated December 20, 2001, approved by the Los Angeles Regional Water Quality Control Board (LARWQCB) on January 25, 2002.
- *Groundwater Monitoring Services Standard Operating Procedures, Boeing Realty Corporation, Former C-6 Facility*, prepared by Tait Environmental Management, dated January 11, 2001.

Natural attenuation sampling was conducted according to:

- *Standard Operating Procedures for Measuring Natural attenuation Parameters at Boeing Realty Corporation Former C-6 Facility, Revision 1.0*, prepared by Haley & Aldrich, Inc. and England Geosystem Inc., dated January 9, 2001.

The following summarizes the activities performed during the Annual Groundwater Monitoring and Sampling event.

- **Groundwater Elevation Measurement**

  - Water levels were measured in 30 Site groundwater wells on March 21, 2002 (Table 2).
  - A groundwater contour map was generated based on the measured groundwater elevations.

- **Well Purging, Sampling and Analysis**

  - At least 3 wetted casing volumes of water were purged with a submersible pump from each well.
  - Groundwater samples were collected with a pump from 30 wells and analyzed for VOCs by EPA Method 8260B.

- **Field Bioattenuation Monitoring**

  - Field bioattenuation monitoring was conducted in six wells by measuring for DO, ORP, temperature, pH, and conductivity.

3.02 Field Procedures

Field procedures for this sampling event are outlined in the documents listed previously in Section 3.01.

3.03 Sample Naming

Groundwater samples were labeled in the following format in accordance with the Groundwater Monitoring Workplan 2002 (Haley & Aldrich, Inc., 2001):

TMW_16_032102_1020

Where:

TMW_16 indicates the groundwater monitoring well number
032102 = date the sample was collected (mmddyy)
1020 = time the sample was collected

IV. MONITORING AND SAMPLING RESULTS

4.01 Groundwater Elevations

Field sheets for the data collected by TEM are included in Appendix A and a summary of the groundwater elevations for the 2002 Annual event is present in Table 2.

During the 2002 Annual event, groundwater elevations at the Site were generally -12 to -15 feet msl, or approximately 60 to 70 feet bgs. The groundwater elevations measured during this event are included in Table 2. Due to Site redevelopment activities, the wells were re-surveyed by a registered land surveyor prior to this sampling event; therefore, the groundwater measurement reference elevations have changed from previous values (up to 6.5 feet above msl). Groundwater elevations have changed approximately 0.5 to 1.5 feet higher compared to the values measured in January/February 2001, except well TMW-4 (decreased approximately 1.4 feet).

Figure 3 is a groundwater elevation contour map of the MBFB (B-Sand) water-bearing zone generated using the data collected during the 2002 Annual event. The hydraulic gradient in the MBFB was measured to be approximately 0.0015 ft/ft to the south and is similar to the gradient of 0.0013 ft/ft to the south measured in July 1999. As shown on Figure 3, the groundwater flows to the south and converges in the western portion of the Site, along Harborgate Way.

Historic groundwater levels are presented in Table 3 and hydrographs for the wells are included as Figures 4a through 4i. The low gradient is demonstrated in the hydrographs by the extremely close proximity of the hydrographs from individual wells.

4.02 Groundwater Quality

VOC Results

Results of VOC analysis by EPA 8260B for the 2002 Annual event conducted in March 2002 are summarized in Table 4. Based on visual observations, there were no indications of dense non-aqueous phase liquid (DNAPL) in any of the sampled wells. General plume geometries for trichloroethene (TCE), 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), and chloroform (CF) appear to be generally unchanged from the previous four sampling events (July 1999, June 2000, January 2001 and June 2001).

Figure 5 shows the dissolved-phase TCE concentrations in the MBFB. TCE concentrations in groundwater samples have decreased or minimally increased (less than 20%) in 26 of the 30 wells. However, TCE concentrations notably increased in samples from four of the 30 wells: DAC-P1 (from 10,000 to 17,000 µg/l), WCC-3S (from 140 to 1,400 µg/l), TMW-6 (from 55 to 160 µg/l), and TMW-8 (from 2,500 to 3,600 µg/l). Noteworthy decreases (greater than 20% variation from the previous sampling event) in TCE concentrations were observed in samples collected from TMW-2 (from 20,000 to 11,000 µg/l) and TMW-3 (from 8,800 to 4,000 µg/l). TCE concentrations in samples from TMW-2 and TMW-3 located near the

postulated VOC source area have declined significantly (82% and 55%, respectively) since the previous monitoring event. Concentration vs. time graphs for TCE are included as Figures 6a through 6g.

Figure 7 shows the dissolved-phase 1,1-DCE concentrations in the MBFB. 1,1-DCE concentrations in groundwater samples have generally decreased or stayed the same in all of the wells, except two: TMW-8 (from 2,200 to 3,100 µg/l and WCC-6S (from 5,026 to 10,000 µg/l). Noteworthy decreases (greater than 20% variation from the previous sampling event) in 1,1-DCE concentrations were observed in samples collected from TMW-2, TMW-3, TMW-1, TMW-5 and WCC-3S. 1,1-DCE continues to remain not detected at TMW-10, TMW-11, TMW-1, BL-3, DAC-P1, WCC-9S, XMW-9 and XMW-18. Concentration vs. time graphs for 1,1-DCE are included as Figures 8a through 8g.

PCE concentrations in groundwater samples have continued to be generally minimal or not detected. Ten of the samples were reported to have detectable concentration of PCE. Three of the ten samples were reported to have concentrations less than 6 µg/l. Five of the ten samples were detected at low levels that could not be qualified by the laboratory (<2 µg/l) and are noted in Table 4 with a "J" flag. The two additional samples that were reported to contain detectable concentrations of PCE were BL-03 (22 µg/l) and XMW-09 (55 µg/l), which were reported to have lower PCE concentrations than the previous sampling event.

1,1,1-TCA concentrations in groundwater samples have decreased or stayed the same in the wells where it was detected, except in well WCC-6S. WCC-6S was reported to have an increased concentration of 780 µg/l from 540 µg/l.

As in previous sampling events, some minor occurrences of VOCs, other then the primary chemicals of concern described above, were detected and are tabulated on Table 4. These occurrences included:

- Chloroform concentrations in groundwater samples, where they have been measured above the detection limit, have generally remained the same or decreased in the TMW series of wells. Within the WCC series, where the concentrations have been reported above the detection limits, chloroform has decreased except in wells WCC-6S and WCC-9S. Chloroform increased from 14 µg/l to 40J µg/l in samples from WCC-6S and from 6.8 µg/l to 24 µg/l in samples from WCC-7S.

- Benzene concentrations in groundwater samples have generally remained the same or decreased in the three wells where it was detected: WCC-3S (from 410 µg/l to below laboratory detection limits), WCC-6S (from 27 to 68J µg/l), and TMW-8 (from 13 to 17J µg/l).

- Methyl ethyl ketone (MEK) (2-butanone) was not detected in any of the wells during this sampling event. In well TMW-2, MEK (2-butanone) decreased from 75,000 µg/l in July 2001 to below laboratory detection limits (<1,200 µg/l) in March 2002.

- Toluene concentrations remained high in three wells: WCC-3S (decreased from 75,000 to 43,000 µg/l); WCC-6S (increased from 350 to 2,500 µg/l); and TMW-2 (decreased from 2,800 to 1,700 µg/l). Low concentrations of toluene were measured consistently (0.42J µg/l to 17J µg/l) in samples from 14 wells.

Field Bioattenuation Parameters

During the monitoring and sampling event, field monitoring of DO, ORP, temperature, conductivity and pH was conducted. A summary of current field bioattenuation parameters is included on the Field Data Sheets in Appendix A and in Table 6. These parameters are similar to the January/February 2001 annual sampling event data and suggest the in-situ conditions have not changed. The distribution of DO and ORP suggest evidence of intrinsic attenuation in the potential source area near former Buildings 1, 2 and 36, and along the southern property boundary. DO has been depleted within the areas of the TCE- and 1,1-DCE-impacted groundwater. ORP is negative within the same areas indicating anaerobic reducing conditions.

V. QUALITY ASSURANCE/QUALITY CONTROL

5.01 Field Quality Control Samples

A. Field Duplicates

Duplicate groundwater samples were analyzed for VOC concentrations from wells WCC-11S and TMW-4. These results are included in Table 4. Laboratory duplicate data can be used to measure how well replicate measurements reproduce and estimate overall method precision. Relative percent difference (RPD) is a measure of precision and is calculated as follows:

$$(\text{Result 1} - \text{Result 2}) / \tfrac{1}{2} (\text{Result 1} + \text{Result 2}) * 100\%$$

Often the RPD will vary with the concentration of analyte, RPD lessening as the concentration increases. If the variation is greater than plus or minus 15% but less than 100%, the reported concentrations are up to standard. If the variation is greater than 100%, the data is subject to further evaluation (i.e., comparison with historic data from the well).

After reviewing the data from the TMW-4 duplicate (validated), there is one analyte that has an RPD value greater than 15%: 1,2-dichloroethane (1,2-DCA) has an RPD of 200%. The RPD for all other detected constituents is 15% or less. There is one analyte from the WCC-11S duplicate (not validated) that has an RPD value greater than 15%: toluene with an RPD of 33%. The RPD for all other detected constituents is less than 15%.

Since well TMW-4 had an RPD greater than 100%, historical groundwater monitoring data was reviewed to evaluate the consistency of the data. Based on the previous 1,2-DCA data from well TMW-4 (7.1 µg/l in July 2001), the most recent result (10 µg/l in March 2002)

appears to be consistent. Based on the data validation and the RPD calculations for duplicates, the field duplicate data appears to be consistent with previous sampling events and is acceptable for use in this report.

B. Equipment Rinsate Blanks

One equipment rinsate blank was collected each day after the sampling equipment was cleaned with deionized water. The rinsate samples were analyzed for VOCs by EPA Method 8260B. An acetone concentration of 14 µg/l was detected in the equipment rinsate blank collected on March 21, 2002 as shown on Table 4.

C. Trip Blanks

One laboratory-prepared trip blank was shipped to the laboratory each day to check for cross-contamination. The samples were analyzed for VOCs by EPA Method 8260B. Minimal concentrations of acetone were detected in two of the trip blanks as shown on Table 4.

D. Laboratory QA/QC Samples

Final laboratory-certified reports and quality control procedures are included on the compact disc (CD) as Appendix B. Data validation results are provided in Appendix C. Appropriate data qualifiers, as determined by Laboratory Data Consultants, Inc. (LDC) (data validation subcontractor), have been included where appropriate.

The data collected during this event is adequate for continued characterization and monitoring of VOCs in groundwater beneath the Site.

VI. CONCLUSIONS

Groundwater levels have increased on average beneath the BRC Former C-6 Facility since the last sampling event by approximately 1.2 feet. The hydraulic gradient beneath the Site remains relatively low, and similar to previously estimated gradients.

In general, concentrations of dissolved chlorinated VOCs have remained approximately the same since the previous monitoring event. The plume geometry remains relatively constant based on the existing well network.

REFERENCES

1. **Haley & Aldrich, Inc. and England Geosystem, 2001.** *Standard Operating Procedures for Measuring Natural Attenuation Parameters at Boeing Realty Corporation Former C-6 Facility.* Revision 1.0, January 9, 2001.

2. **Haley & Aldrich, 2001.** *Groundwater Monitoring Workplan 2001*, dated December 20, 2001.

3. **Kennedy/Jenks Consultants, 2000.** *Groundwater Status Report,* dated October 27, 2000.

4. **Poland, J.F., Garnett, A.A., and Sinnott, A., 1959.** *Geology, Hydrology and Chemical Characteristics of the Ground Waters in the Torrance-Santa Monica Area, California*, USGS Water Supply Paper 1461.

5. **Sate of California, Department of Water Resources, 1961.** *Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County*, Appendix A Ground Water Geology.

6. **Tait Environmental Management, Inc., 2001.** *Boeing Realty Corporation, Former C-6 Facility, Groundwater Monitoring Services, Standard Operating Procedures.* January 11, 2001.

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